Why do states adopt energy-driven tax incentives?

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Abstract

In the past few decades there has been an increased interest in energy efficient technologies and renewable forms of energy for power generation. Many U.S. states have adopted various forms of tax incentives to remove cost barriers and to encourage the use of energy efficient technologies and renewable energy. A large literature has examined the effectiveness of these tax incentives; however, this literature has placed little emphasis on the factors associated with adoption of these policies. The purpose of this study is to establish a precursor to the analysis of these types of policies' effectiveness on the state level: an investigation into the reasons states adopt these tax incentives. Relevant tax incentive data for each of the 50 states was obtained from the Database of State Incentives for Renewables & Efficiency (DSIRE), while information about each state's adoption factors was obtained from various federal government websites. The relationships between these variables for the 50 states were explored using a cross-sectional regression analysis. The findings reveal that the ideology of a state's citizenry is associated with having more tax incentives for energy efficiency and renewable energy; Democratic-leaning states are more likely to adopt environmental tax incentives. In contrast, a state's energy prices, wealth, and carbon dioxide emissions do not influence the number of these types of incentives adopted. Finally, states with a higher average annual percentage of sunny days adopt a greater number of tax incentives for solar power.

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I. Introduction

In both political and business spheres in recent decades, the topics of climate change, environmental awareness, and energy independence have become increasingly relevant. Thus, various levels of government in the U.S. have sought to implement policy to mitigate energy related concerns such as rising energy prices, energy security, fossil fuel scarcity, and greenhouse gas emissions. In particular, these concerns have heightened political interest in the implementation of financial incentives to promote the use of various forms of renewable energy and energy efficient buildings, homes, and appliances. Nevertheless, alternative energy sources such as solar power, wind power, and hydroelectric power are often perceived as less attractive in relation to traditional, nonrenewable forms of energy because they are more costly. Consequently, financial incentives are frequently perceived as a policy tool to overcome these barriers (Menz and Vachon, 2006).

The present interest in renewable energy and energy efficiency may result in the implementation of federally defined targets for energy efficiency and renewable power generation. However, on a federal level the U.S. currently offers few financial incentives to promote these activities (Young and Sarzynski, 2009). In addition, the U.S. imposes virtually no environmental or "green" taxes. A majority of programs to reduce pollution and address climate change hinge upon mandatory standards such as the Clean Air Act's New Source Performance Standards (NSPS) for stationary polluters and the Corporate Average Fuel Economy (CAFÉ) standards for automobiles (Levison, 2007).

In contrast, historically state governments have been active in initiating financial incentives to encourage the use of renewable energy and energy efficient technologies (Rabe, 2004). These incentives appear in the form of income tax incentives such as personal and/or corporate credits, exemptions, and deductions, cash incentives such as grants and rebates, sales tax incentives, property tax incentives, and financing incentives such as favorable loan terms (Young and Sarzynski, 2009). State investigation of renewable energy policy began in the 1970s in response to the growing environmental movement and the energy crisis. Specifically, in 1974 Arizona and Indiana adopted property tax incentives to spur the purchase of residential solar technology. By 1976, 28 states had adopted various incentives and by 1981 the total number of states with incentives increased to 44 (Hinds, 1981). Both federal and state interest in financial incentives to promote environmental health dwindled during the 1980s and 1990s, but great interest has been renewed in the twenty-first century.

As the implementation of financial incentives to address environmental concerns is debated on the federal level, it raises the question of the effectiveness of these various policy tools on the state level. Furthermore, the implementation of additional financial incentives such as tax exemptions or subsidies to promote clean energy must be weighed against commonly expressed desires to lower rates and to simplify the tax code by having fewer deductions and credits. In this context, policymakers on a federal level are likely interested in the effectiveness of the above financial incentives in promoting the use of renewable energy and energy efficient technology on the state level. A crucial precursor to the analysis of these types of policies' effectiveness on the state level is a comprehensive investigation of the factors that influenced each given state to adopt them in the first place. A majority of research on the effectiveness of state policy in the generation of renewable energy lacks analyses of the natural and institutional conditions that could influence their effectiveness (Delmas and Montes-Sancho, 2011). For example, prior literature generally ignores important questions: Were these policies adopted to achieve the stated intentions of spurring the use of clean energy? Were the factors which led to their adoption evaluated in terms of a given policy's predicted ability to be effective in achieving environmental protection? Rather than utilizing a one-size-fits-all approach, policymakers should ideally evaluate and understand the state-specific factors that affected a state's adoption of its various financial incentives to promote clean energy use.

This paper utilizes a cross-sectional regression analysis of the 50 states to explore numerous factors which could influence a state's adoption of tax incentives for renewable energy and energy efficiency. Specifically, the influence of a state's energy context to adopt incentives is evaluated in terms of factors such as total energy cost, energy-related carbon dioxide emissions, and the average annual percentage of sunny days. Thus, it poses multiple related questions. For example, does a state's energy prices influence its support for renewable energy? Intuitively, does a state's solar potential influence the frequency of adoption for tax incentives related to solar power? The paper also analyzes a number of socio-economic and political factors that could affect the adoption of tax incentives for renewables and energy efficiency, including each state's real GDP, general fund balance, population, and political orientation.

The results reveal that a state's citizen ideology has the greatest influence in the adoption of tax incentives to promote energy efficient technologies and renewable energy. A state's energy context, or the abundance of natural resources in a state, also affects the number and types of incentives adopted. In particular, states with a higher average annual percentage of sunny days adopt a greater number of tax incentives for solar power. Measurements of a state's pollution such as carbon emissions levels and a state's wealth and economy such as GDP and energy prices do not affect the number of tax incentives adopted.

The paper is organized as follows. Section II provides an overview of the various types of tax policies utilized as financial incentives for renewable energy and energy efficiency across the states. Section III provides a review of existing literature which evaluates the various factors that may lead to an energy-related financial incentive's adoption and its effectiveness. Sections IV and V provide the research hypotheses and methodology while sections VI and VII provide the results and conclusion, respectively.

II. Types of Tax Incentives across the States

In order to examine my research questions, I obtain data pertaining to the number of tax incentives, types of tax incentives, and the activities they encouraged for 2013 from the Database of State Incentives for Renewables and Efficiency (DSIRE). As depicted in Table 1, there is considerable variation in the number of energy-related tax incentives states have. For example, Arizona, Iowa, Maryland, New Mexico, New York, and Oregon were the only states to offer double-digit quantities of tax incentives for renewables and energy efficiency. In contrast, Arkansas, Delaware, Maine, Mississippi, and Wyoming did not offer any tax incentives to promote the use of energy efficient technologies or renewable energy. The remainder of states were somewhere in between, with an average of 4.82 different incentives offered per state. Property tax incentives were most commonly offered incentives across the states, while corporate tax deductions and exemptions were the least frequently offered.

Table 2 indicates that tax incentives relating to the generation of solar power were most frequently adopted (156), followed by incentives for wind (123) and biomass (102). A total of 44 tax incentives for energy efficient technologies were offered across the states.

III. Literature Review

Several political science and policy studies examine what explains the factors which influence a given type of policy's adoption across states (e.g., Graham, Shipan, and Volden, 2008). However, results are mixed. In terms of policies to promote environmental protection, Matisoff, (2008) conducted an analysis of renewable portfolio standards (RPS) by states from 1997 to 2005. RPS policies restrict a state's utilities to produce and purchase a specified amount of electricity produced from renewable resources (Wiser and Barbose, 2008). Matisoff found that a state's pollution levels and the capability for solar and wind production influenced the adoption of RPS policies, whereas the size of a state's economy in terms of gross product per capita did not influence adoption. Matisoff found that the political ideology of a state's population was the most influential factor in the adoption of RPS policies.

Stoutenborough and Beverlin (2008) examined the adoption of net-metering policies across the states. These policies ensure that utilities pay customers for the excess electricity they produce on their own, including solar residential technology (Young and Sarzynski, 2009). In an analysis of numerous state political and social variables, Stoutenborough and Beverlin also discovered mixed results. Specifically, they found that states with more liberal governments and the presence of a public utility commission were more likely to adopt net-metering policies. In contrast to Matisoff's findings, they did not find relationships between population density or the ideology of a state's citizens and the adoption of net-metering policies. For variables related to a state's energy context, Stoutenborough and Beverlin discovered that solar potential did not influence a state's adoption of net-metering policies, while wind power did influence adoption. Finally, they found that states that consumed more energy were more likely to adopt net-metering policies, as were states that generally adopted a greater number of other environmentally-friendly policies.

Young and Sarzynski (2009) investigated the adoption of solar energy financial incentives across the U.S. states from 1974 to 2007. In regards to a state's energy context, they discovered that states with a greater solar potential were more likely to adopt these types of financial incentives, as were states with higher energy prices. Similar to Sawyer and Friedlander (1983), they found that citizen ideology was the most influential factor in a state's adoption of financial incentives for solar power. On the other hand, they found that a state's GDP per capita had no effect on the implementation of the financial incentives.

Delmas and Montes-Sancho (2011) investigated various factors influencing the implementation of RPS and Mandatory Green Power Options (MPGO) across the states. MPGO policies require a state's electric utilities to offer customers "green power" from their own power generation or the purchase of renewable energy credits (RECs). First of all, in terms of a state's energy context, they found that a state's potential to produce wind power was positive and significant in predicting the use of RPS and MPGO. Secondly, they found that a state's solar power potential was positive and significantly related to RPS but negatively to MPGO. Biomass resources were negatively related to RPS and MPGO policies. In terms of socio-economic and political variables, Delmas and Montes-Sancho determined that the percentage of seats in a state legislature occupied by Democrats and the presence of a Democratic governor were both positively and significantly related to the implementation of RPS and MPGO policies. Finally, they found that deregulation and disclosure programs were insignificant in predicting the adoption of these policies.

In addition, Menz and Vachon (2006) and Lyon and Lin (2008) found that it may be easier to introduce policies in states with a greater endowment of natural resources, since renewable "natural capital" such as wind and solar are difficult to move around and geographic specific.

There has also been abundant research regarding the effectiveness of these incentives. For example, Delmas et al. (2010) discovered that state tax incentives were insignificant in determining the fuel-mix ratio of electric utilities. Carley (2009) found that while subsidies have a positive and significant correlation with development of renewable energy, tax incentives actually displayed a negative and significant correlation.

IV. Hypotheses

a. Energy Context

A given state's environmental context should be assessed as a possible factor in the adoption of tax incentives for renewable energy and energy efficiency. A state's energy context is defined as the amount of natural capital it retains, or the "stock that yields the flow of natural resources" (Daly, 1996).

Stoutenborough and Beverlin (2008) found that states that consumed more energy were more likely to adopt net-metering policies. Additionally, Young and Sarzynski (2009) discovered that states with higher energy prices were more likely to adopt various financial incentives to encourage the use of solar power. These results reflect the assumption that regions with higher energy or electricity prices would seek alternative energy sources to capture future savings. These assumptions lead to the first hypothesis.
Hypothesis 1: States with higher total energy costs are more likely to adopt incentives for both energy efficient technology and renewable energy.

Matisoff (2008) found that a state's pollution levels impacted the adoption of RPS policies. Policymakers could logically seek increased implementation of financial incentives for cleaner forms of alternative energy and energy efficiency. These policy tools could reasonably be viewed as a means to lower energy usage and to mitigate the impacts of pollution on the environment. A common concern is the impact of carbon emissions on the environment. These supporting findings and assumptions contribute to the second hypothesis.

Hypothesis 2: States with higher levels of carbon emissions are more likely to adopt incentives for both energy efficient technology and renewable energy.

One might assume that states with more sunshine would be more inclined to implement policies to promote solar power and realize the potential benefits of this renewable form of power generation. Numerous previous research findings also support this basic assumption. As mentioned in section III, both Matisoff (2008) and Delmas and Montes-Sancho (2011) discovered that the implementation of renewable portfolio standards was influenced by a state's potential solar production. Young and Sarzynski discovered that states with a greater solar potential were more likely to adopt financial incentives for solar power generation. Conversely, one might anticipate the exact opposite conclusion – residents in states with less sunshine may need more financial incentives to make the use of solar economically viable, as fewer sunny days means less solar energy for installation of a solar panel. Stoutenborough and Beverlin's analysis showed that solar potential did not influence a state's adoption of net-metering policies. In light of the discrepancies in the literature, I examine this question, formally testing my third hypothesis.

Hypothesis 3: States with greater solar potential are more likely to adopt tax incentives for solar power generation.

b. Socio-Economic and Political Context

Along with a state's energy context, its socio economic and political context must be analyzed to determine what drives the adoption of tax incentives for renewable energy and energy efficiency. These contexts encompass factors such as a state's wealth and political ideology.

Utilizing various measurements to determine a state's wealth, the literature suggests that wealth does not affect the adoption of incentives for renewable energy and energy efficiency. Specifically, as summarized in section III, Matisoff (2008) found that the size of a state's economy in terms of gross product per capita did not influence the adoption of RPS policies. Also, Young and Sarzynski (2009) found that a state's GDP per capita had no effect on the implementation of the financial incentives. These findings support the fourth hypothesis.

Hypothesis 4: A state's wealth does not influence the adoption of tax incentives for energy efficient technology and renewable energy.

Numerous studies have revealed that a state's political environment assumes a role in the implementation of various policies to promote the use of energy efficient technology and renewable energy. In addition, research findings demonstrate the tendency of more liberal governments to pursue these policies. Conventionally, it appears that liberal political figures express a greater concern toward protecting the environment and the potential ramifications of climate change.

As previously noted, Matisoff (2008) found that the political ideology of a state's population was the most significant factor in the adoption of RPS standards. Furthermore, Young and Sarzynski (2009) and Sawyer and Friedlander (1983) found that citizen ideology was the most influential factor in a state's adoption of financial incentives for solar power. Delmas and Montes-Sancho (2011) determined that the percentage of seats in a state legislature occupied by Democrats and the presence of a Democratic governor were both positively and significantly related to the implementation of RPS and MPGO policies. While Stoutenborough and Beverlin (2008) did not find a relationship between the ideology of a state's citizens and the adoption of net-metering policies, they did find that that states with more liberal governments were more likely to adopt net-metering policies. These findings lead to the final hypothesis.

Hypothesis 5:

V. Methodology

a. Sample Selection

The sample to test each hypotheses is simply each of the 50 states. For each state, I obtained data relating to various environmental, socio-economic, and political factors as measured in a single year, 2013, in order to perform a cross-sectional analysis.

b. Variable Measurement

This section describes how I obtained and measured each of the independent and dependent variables identified in the hypotheses in section IV.

In order to test my research question, I obtained data on the total quantity of tax incentives available to encourage the use of energy efficient technology and renewable energy in each state, as well as the number of tax incentives for solar power. I obtained data for the dependent variables from the Database of State Incentives for Renewables &

Efficiency (DSIRE). DSIRE is the most comprehensive source of information on incentives and policies supporting renewable energy and energy efficiency in the United States. To obtain the data, I visited DSIRE's program database and categorized tax incentives by the total number of financial incentives in each state. I also categorized the total number of tax incentives by type (individual vs. corporate credits and deductions, sales tax, property tax, etc.) and the activity incented (efficiency, solar, wind, etc.)

All of the independent variable data also reflects measurements from the year 2013. In terms of the energy context, the independent variable for Hypothesis 1, total energy costs, reflects total end-use energy price estimates measured in dollars per million btu. I gathered this data from the U.S. Energy Information Administration's website, eia.gov. Data for hypothesis 2, levels of carbon dioxide emissions, is measured in million metric tons. For hypothesis 3, I measured solar potential in terms of the average annual percentage of sunny days in each state. I obtained this data from the National Oceanic and Atmospheric Administration (NOAA).

In terms of the socio-economic and political context, Hypothesis 4 data reflecting a state's wealth is measured in terms of real GDP per capita. Data for GDP is measured in terms of millions of chained 2009 dollars, and I obtained this data from the U.S. Department of Commerce's Bureau of Economic Analysis, bea.gov. A state's general fund balance is measured in millions of dollars, scaled for population, and this data is available on the National Association of State Budget Officers' website, nasbo.org. Finally, for Hypothesis 5 a state's political ideology is measured in terms of the percentage of a state's citizens that "lean Democratic." I obtained this data from a 2013

Gallup Poll in which over 178,000 U.S. adults were interviewed, with each state's data weighted to match the U.S. demographic parameters for that state's adult population.

c. Research Design

I utilize regression analysis to test each of the hypotheses highlighted in section III as measured by the variables described in section IV b. A dummy variable is used to control for whether each state collects a state income tax. The remainder of variables are measured on a scale as continuous variables. Hypotheses 1, 2, 4, and 5 identify the total number of incentives available as the dependent variable. I estimate the following regression equation.

$$\textit{Total Number of Incentives} = \beta_0 + \beta_1 \textit{GDP per Capita} + \beta_2 \textit{Total Energy Costs} + \beta_3 \textit{Percent Lean Democratic} + \beta_4 \textit{Population} + \beta_5 \textit{Population Density per Square Mile} + \beta_6 \textit{Percentage of Sunny Days} + \beta_7 CO_2 \textit{ Emissions} + \beta_8 \textit{ State Income Tax} + \beta_9 \textit{ General Fund Balance} + \varepsilon \qquad (1)$$

For each of the above hypotheses, I test whether the appropriate β is different than zero (β_2 in H1; β_7 in H2; $\beta_{1,}$ and β_9 in H4; β_3 in H5). The state income tax variable, $\beta_{8,}$ controls for differences in tax incentives influenced by whether a state implements an income tax. I also control for total population in terms of population density per square mile, $\beta_{5,}$ in order to control for other forms of variance that do not reflect the relationship for the coefficient of interest.

Hypothesis 3, which posits a positive relationship between the number of tax incentives available for solar power generation and the annual percentage of sunny days per state, is tested using the following regression equation.

Number of Solar Incentives = β_0 + β_1*GDP per capita* + β_2*Total Energy Costs* + β_3*Percent Lean Democratic* +β_4*Population* + β_5*Population Density per Square Mile* + β_6*Percentage of Sunny Days* + β_7*CO_2 Emissions* + β_8*State Income Tax* + β_9*General Fund Balance* + ε *(2)*

As in Equation 1, in addition to the variable of interest I am testing (Percentage of Sunny Days), other independent variables are inserted into the equation to control for variance which does not reflect the relationship under investigation.

VI. Results

The regression output results for Hypotheses, 1, 2, 4, and 5 are displayed in Table 3. My estimation of "R-squared" is 0.1662, which indicates that the identified independent variables explain 16.62 percent of the variability in the dependent variable, the total number of tax incentives for energy efficiency and renewable energy in the states.

Hypothesis 1 predicted that states with higher total energy costs would be more likely to adopt incentives for both energy efficient technology and renewable energy. The results do not support this hypothesis. As exhibited in Table 3 (1), for every one unit increase in total energy costs (measured in end use energy price estimates, dollars per million btu), the number of relevant tax incentives offered decreases roughly 0.0637. However, in evaluating statistical significance, the p-value reveals that this estimate is not statistically different from zero. This may well stem from my lack of statistical power, measurement error (my variables may not properly capture the constructs they were intended to capture), or, the relationship may simply not exist.

Hypothesis 2 predicted that states with higher levels of carbon emissions would be more likely to adopt incentives for both energy efficient technology and renewable energy. The results do not support this hypothesis. As exhibited in Table 3 (1), for every one unit increase in carbon emissions (measured in millions of metric tons), the number of relevant tax incentives offered decreases 0.001622. Once again, the high p-value's insignificance reveals that the independent variable carbon emissions is not statistically significant.

Hypothesis 3 predicted that states with greater solar potential would be more likely to adopt tax incentives for solar power generation. The results support this hypothesis. As exhibited in Table 3 (2), for every unit increase in the annual percentage of sunny days, the number of tax incentives for solar power generation increases 0.1607188. In addition, the p-value of less than 0.01 indicates that this relationship is statistically significant.

Hypothesis 4 predicted that a state’s wealth does not influence the adoption of tax incentives for energy efficient technology and renewable energy. Wealth is reflected in the coefficients for GDP per capita and scaled general fund balances. The results in Table 3 (1) reflect this hypothesis, as revealed by the insignificant p-values for the GDP per capita and a state's scaled general fund balance.

Hypothesis 5 predicted that liberal states would be more likely to adopt tax incentives for energy efficiency and renewable energy. The results in Table 3 (1) support this hypothesis. For every unit increase in liberalness, as measured by the percentage of a state’s sampled citizens that lean Democrat, the number of total tax incentives increases by 0.242. The p-value of less than 0.15 indicates that this positive relationship is also statistically significant in terms of the 50 observations.

VII. Conclusion

I investigated various energy, socio-economic, and political factors which could influence a state's adoption of tax incentives to encourage the use of energy efficient technology and renewable energy. The results of abundant research analyzing the effectiveness of these types of incentives across the states is mixed. However, a majority of this research fails to incorporate supporting analyses of the environmental, economic, and political factors that influence the incentives' implementation. While previous research has generally investigated the impact of environmental, economic, and political factors on the implementation of rules and regulations such as Renewable Portfolio Standards and Mandatory Green Power Options, this paper focuses on tax incentives as a representation of financial incentive implementation.

This paper confirms the notion that the political context matters, a common finding in previous research pertaining to factors influencing the implementation regulations and financial incentives for renewables and energy efficiency. The multiple regression analysis results suggest that a state's political ideology, as measured by the percentage of citizens that identify as Democrats, has the greatest influence on the number of tax incentives adopted. In terms of democratic governance, this result can be viewed positively, as it suggests that citizen ideology serves as an established limit on the policies states will pursue (Erikson et al., 1993). In other words, elected officials' behavior is shaped by the beliefs of the citizens they represent.

An assumption is that environmental tax incentives promote environmental protection by encouraging taxpayers to engage in certain environmentally conscious activities. At first glance, it is not surprising that Democrats would support policies to protect the environment. This assumption is supported by abundant survey data. To illustrate, a 2013 Pew Research poll found that views on protecting the environment created the widest partisan gap between Democrats and Republicans in comparison with other issues such as gun control and health care. While 69 percent of Democrats viewed environmental protection as a top public policy priority, only 32 percent of Republicans shared this belief ("Many More Democrats," 2013). Similarly, a 2014 Gallup poll revealed that 45 percent of Democrats were concerned about the quality of the environment, while only 16 percent of Republicans were concerned (Riffkin, 2014).

However, many of the environmental state tax incentives also act at as tax cuts for wealthy individuals. Specifically, approximately half of the state incentives listed on DSIRE are residential and require home ownership (1330 of 2662 entries), which suggests that the benefitting taxpayers are relatively wealthy. This is interesting because it defies the conventional wisdom that the wealthy will benefit more with Republican tax policies, as Democrats oppose tax cuts for the rich. Republicans are generally identified as favoring across-the-board tax cuts for individuals of all income levels and for corporate interests. Conversely, Democrats appear to generally favor tax cuts only for lower and middle-income families and tax increases for wealthy individuals and corporations. These concepts are illustrated by a 2011 Gallup poll that posed the following question: “Do you think our government should or should not redistribute wealth by heavy taxes on the rich?” While 71 percent of Democrat respondents favored heavy taxes on the rich, only 28 percent of Republicans supported heavy taxes (Saad, 2011). In essence, tax cuts for the wealthy to promote economic growth are generally viewed to represent Republican tax policy. Nevertheless, in effect these incentives to promote the more liberal ideals of environmental protection similarly act as tax cuts for the wealthy. Thus, this paper provides insight into the complexity of tax politics in America.

Additionally, the analysis confirms the intuitive assumption that states with more sunshine, a variable reflecting a state’s environnmental or energy context, are more prone to take advantage of solar power potential through the implementation of related tax incentives. This suggests more broadly that state tax incentives for power generation are designed to take advantage of the state’s natural resource availability. On the other hand, the results suggest that economic factors such as a state’s energy prices and wealth as measured by its GDP per capita and general fund balances scaled have little to no influence on the implementation of tax incentives to promote renewables and energy efficiency. These results stand in opposition to the findings of Young and Sarzynski that states with higher energy prices are more likely to adopt various financial incentives for renewable energy. Finally, the resulting lack of a relationship between a state’s level of carbon emissions and number of tax incentives adopted contrasts Matisoff’s suggestion of a positive relationship between pollution levels and the number of RPS policies.

References

Bureau of Economic Analysis, U.S. Department of Commerce. (2015, June 10). *Broad Growth Across States in 2014: Advance 2014 and Revised 1997-2013 Statistics of GDP by State* [Press release]. Retrieved from https://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm

Carley, S. (2009). State renewable energy electricity policies: An empirical evaluation. *Energy Policy* 37: 3071-3081.

Daly, H.E. (1996). *Beyond Growth: The Economics of Sustainable Development.* Beacon Press: Boston, MA.

Database of State Incentives for Renewables and Efficiency. (n.d.). Retrieved from http://programs.dsireusa.org/system/program

Delmas, M. and M. Montes-Sancho. (2011). An Institutional Perspective on the Diffusion of International Management System Standards: the Case of the Environmental Management Standard ISO 14001. *Business Ethics Quarterly*. 21(1): 1052-1081.

Delmas, M., J. Shimshack, and M. Montes-Sancho. (2010). Information Disclosure Policies: Evidence from the Electricity Industry. *Economic Inquiry*, 48(2): 483-498.

Erikson, R., G. Wright, and J. McIver. (1993). *Statehouse Democracy: Public Opinion and Policy in the American States* Cambridge: Cambridge University Press.

Graham, E., C. Shipan, and C. Volden. (2008). "The Diffusion of Policy Diffusion Research." Manuscript, Ohio State University.

Hinds, M.D. (1981, September 17). New credits brighten solar sales future. *New York Times*, pp. C1, C12.

Levinson, A. (2007). Taxes and the Environment: What Green Taxes Does the United States Impose? *Tax Policy Center*. Urban Institute, Brookings Institution.

Lyon, T.P. and H. Yin, (2008). Why Do States Adopt Renewable Portfolio Standards?: An Empirical Investigation. Mimeo, University of Michigan.

Many More Democrats Than Republicans Say Protecting Environment a Top Priority. (2013, February 5). Retrieved from http://www.pewresearch.org/daily-number/many-more-democrats-than-republicans-say-protecting-environment-a-top-priority/

Matisoff, D. (2008). "The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants." Review of Policy Research 25: 527-546.

Menz, F. and Vachon, S. (2006). The effectiveness of different policy regimes for promoting wind power: Experiences from the states. *Energy Policy* 34: 1786-1796.

National Oceanic and Atmospheric Administration, U.S. Department of Commerce. (n.d.). *NOAA National Data Centers*. Retrieved from http://www1.ncdc.noaa.gov/pub/data/ccd-data/CCD-2014.pdf

Population of USA States. (2015, August 11). Retrieved from http://www.worldatlas.com/aatlas/populations/usapoptable.htm

Rabe, B. (2006). *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy* Washington, DC: Brookings Institution Press.

Riffkin, R. (2014, March 12). Climate Change Not a Top Worry in U.S. Retrieved March 27, 2016, from http://www.gallup.com/poll/167843/climate-change-not-top-worry.aspx

Saad, L. (2011, June 2). Americans Divided on Taxing the Rich to Redistribute Wealth. Retrieved from http://www.gallup.com/poll/147881/americans-divided-taxing-rich-redistribute-wealth.aspx

Saad, L. (2014, January 29). Not as Many U.S. States Lean Democratic in 2013. Retrieved from http://www.gallup.com/poll/167030/not-states-lean-democratic-2013.aspx

Sawyer, S.W., & Friedlander, S.C. (1983). State renewable energy tax incentives: monetary values, correlations, policy questions. *Energy Policy* 11: 272-277.

Stoutenborough, J. and M. Beverlin. (2008). "Encouraging Pollution-Free Energy: The Diffusion of State Net Metering Policies," *Social Science Quarterly* 89: 1230-1251.

The Fiscal Survey of States: Fall 2013 (Rep.). (2013). Retrieved from http://www.nasbo.org/sites/default/files/NASBO Fall 2013 Fiscal Survey of States.pdf

U.S. Census Bureau, Population Division. (2014, June). *Annual Estimates of the Resident Population by Sex, Race Alone or in Combination, and Hispanic Origin for the United States, States, and Counties: April 1, 2010 to July 1, 2013*. Retrieved from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

U.S. Energy Information Administration, U.S. Department of Energy. (2015, October 26). *Energy-Related Carbon Dioxide Emissions at the State Level, 2000-2013*. Retrieved from http://www.eia.gov/environment/emissions/state/analysis/pdf/table1.pdf

U.S. Energy Information Administration, U.S. Department of Energy. (2015, July 24). *State Energy Data System (SEDS): 1960-2013 (complete)*. Retrieved from http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_pr_tx.html

Wiser, R. and G. Barbose. (2008). *Renewables Portfolio Standards in the United States: A Status Report with Data Through 2007* Report, Lawrence Berkeley National Laboratory.

Young, G. and A. Sarzynski. (2009). The Adoption of Solar Energy Financial Incentives Across the States, 1974-2007. *George Washington Institute of Public Policy*.

Appendix

Table 1: Total Number of Tax Incentives for Renewable Energy and Energy Efficiency per State as of 2013

State	Number of Corporate Tax Credits	Number of Corporate Tax Deductions	Number of Corporate Tax Exemptions	Number of Personal Tax Credits	Number of Personal Tax Deductions	Number of Property Tax Incentives	Number of Sales Tax Incentives	Total
Alabama	0	0	0	0	1	0	0	1
Alaska	0	0	0	0	0	1	0	1
Arizona	3	0	0	4	1	3	1	12
Arkansas	0	0	0	0	0	0	0	0
California	0	0	0	0	0	1	1	2
Colorado	0	0	0	0	0	4	3	7
Connecticut	0	0	0	0	0	2	3	5
Delaware	0	0	0	0	0	0	0	0
Florida	1	0	0	0	0	1	1	3
Georgia	0	0	0	0	0	0	2	2
Hawaii	1	0	0	1	0	1	0	3
Idaho	0	0	0	0	2	1	0	3
Illinois	0	0	0	0	0	2	1	3
Indiana	0	0	0	0	1	1	1	3
Iowa	2	0	1	3	0	3	1	10
Kansas	0	0	0	0	0	1	0	1
Kentucky	3	0	0	2	0	0	2	7
Louisiana	1	0	0	1	0	1	0	3
Maine	0	0	0	0	0	0	0	0
Maryland	1	0	0	1	0	18	5	25
Massachusetts	0	1	1	1	0	1	1	5
Michigan	0	0	0	0	0	1	0	1
Minnesota	0	0	0	0	0	1	2	3
Mississippi	0	0	0	0	0	0	0	0
Missouri	1	0	0	0	1	1	1	4
Montana	1	1	0	4	0	3	0	9
Nebraska	1	0	0	1	0	1	2	5
Nevada	0	0	0	0	0	4	1	5
New Hampshire	0	0	0	0	0	1	0	1
New Jersey	0	0	0	0	0	2	1	3
New Mexico	6	0	0	7	0	1	4	18
New York	1	0	0	2	0	6	4	13
North Carolina	1	0	0	1	0	2	0	4
North Dakota	1	0	0	1	0	2	3	7
Ohio	0	0	0	0	0	6	2	8
Oklahoma	2	0	0	1	0	1	0	4
Oregon	5	0	0	6	0	2	0	13
Pennsylvania	0	0	0	0	0	1	0	1
Rhode Island	0	0	0	0	0	2	1	3
South Carolina	3	0	0	3	0	0	2	8
South Dakota	0	0	0	0	0	2	1	3
Tennessee	0	0	0	0	0	1	1	2
Texas	0	1	0	0	0	5	1	7
Utah	2	0	0	2	0	0	1	5
Vermont	0	0	0	1	0	2	1	4
Virginia	0	0	0	0	2	4	1	7
Washington	0	0	0	0	0	0	1	1
West Virginia	0	0	1	0	0	1	0	2
Wisconsin	1	0	0	1	0	1	1	4
Wyoming	0	0	0	0	0	0	0	0
Total	37	3	3	43	8	94	53	241

Table 2: Types of Energy Efficiency and Renewable Energy Incentives by State as of 2013								
State	**Efficiency**	**Solar**	**Wind**	**Biomass**	**Fuel Cells**	**Geothermal**	**Hydroelectric**	**Ocean**
Alabama	0	0	0	1	0	0	0	0
Alaska	0	1	1	1	0	0	1	0
Arizona	1	10	10	7	2	1	2	0
Arkansas	0	0	0	0	0	0	0	0
California	0	2	0	0	0	0	0	0
Colorado	0	7	4	4	0	4	1	0
Connecticut	1	3	2	2	2	4	2	2
Delaware	0	0	0	0	0	0	0	0
Florida	0	3	2	2	0	2	1	1
Georgia	1	0	0	1	0	0	0	0
Hawaii	0	3	3	1	0	0	0	1
Idaho	1	1	2	1	0	2	0	0
Illinois	0	1	2	0	0	0	0	0
Indiana	0	2	2	1	0	1	2	0
Iowa	0	6	6	4	2	2	2	0
Kansas	0	1	1	1	0	1	1	0
Kentucky	3	4	4	2	0	2	2	0
Louisiana	0	3	0	0	0	0	0	0
Maine	0	0	0	0	0	0	0	0
Maryland	8	16	10	8	0	13	7	2
Massachusetts	0	5	5	0	0	1	1	0
Michigan	0	0	0	1	0	0	0	0
Minnesota	0	2	2	0	0	0	0	0
Mississippi	0	0	0	0	0	0	0	0
Missouri	2	1	0	1	0	0	0	0
Montana	2	6	6	6	6	7	6	0
Nebraska	0	5	5	5	2	3	3	0
Nevada	1	4	4	3	2	4	4	0
New Hampshire	0	1	1	1	0	0	0	0
New Jersey	0	3	2	2	1	1	1	1
New Mexico	2	11	5	5	1	5	0	0
New York	2	8	3	6	0	2	1	0
North Carolina	0	4	2	2	0	2	2	0
North Dakota	0	3	4	3	3	4	1	0
Ohio	3	5	5	3	3	4	3	0
Oklahoma	2	1	2	0	0	1	1	0
Oregon	5	7	3	6	2	5	2	1
Pennsylvania	0	0	1	0	0	0	0	0
Rhode Island	0	3	2	1	0	2	1	0
South Carolina	3	2	0	2	1	0	2	0
South Dakota	0	2	3	2	2	2	2	0
Tennessee	0	2	2	1	1	2	0	0
Texas	4	3	3	2	0	1	1	0
Utah	0	5	5	5	1	5	5	0
Vermont	0	4	3	3	3	1	1	0
Virginia	3	3	1	1	1	1	1	1
Washington	0	1	1	1	0	1	0	1
West Virginia	0	0	2	0	0	0	0	0
Wisconsin	0	2	2	4	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0
Total	44	156	123	102	35	86	59	10

Table 3:
The Number of State Tax Incentives as a Function of Environmental, Socio-Economic and Political Contexts

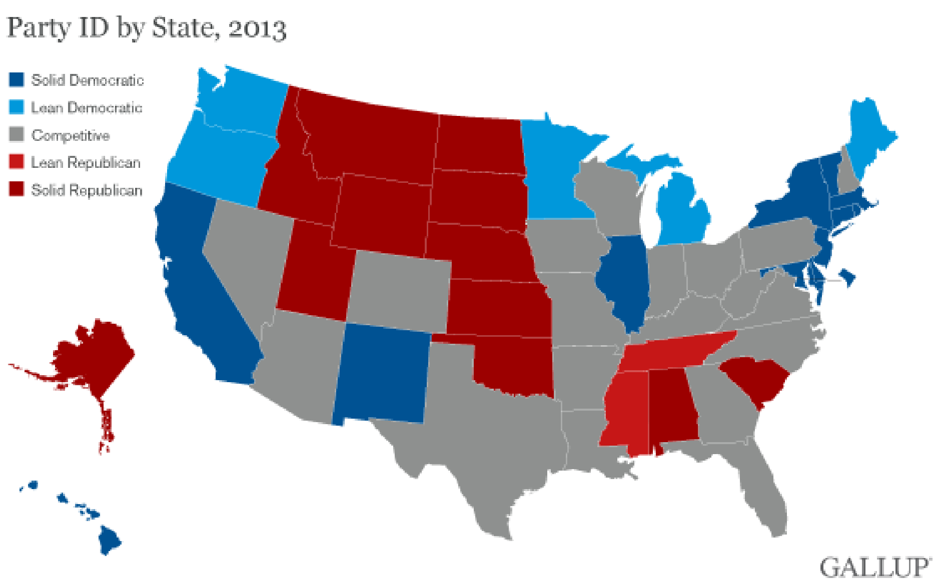
	(1) Total Incentives	(2) Solar Power Incentives
GDP per Capita	117.8	103.7
	(1.11)	(1.56)
Total Energy Costs	-0.0637	0.0348
	(-0.26)	(0.22)
Percent Lean Democratic	0.242*	0.158*
	(1.65)	(1.71)
Population	-8.83e-08	-6.53e-08
	(-0.42)	(-0.50)
Population Density per Square Mile	-0.00280	-0.00145
	(-0.76)	(-0.62)
Average Annual Percentage of Sunny Days	0.173*	0.161***
	(1.95)	(2.87)
Carbon Emissions	0.00162	-0.000759
	(0.12)	(-0.09)
State Income Tax Existence	-1.699	-1.017
	(-0.71)	(-0.67)
General Fund Balance Scaled	833.9	-238.3
	(0.31)	(-0.14)
Constant	-18.60*	-17.65**
	(-1.74)	(-2.62)
N	50	50

Note: t statistics in parentheses
statistical significance: *p<0.15, **p<0.05, ***p<0.01

Table 4: Top 5 States with the Most Environmental Tax Incentives

State	Number of Total Incentives	Political Leanings
Maryland	25	Solid Democrat
New Mexico	18	Solid Democrat
New York	13	Solid Democrat
Oregon	13	Lean Democrat
Arizona	12	Competitive

Figure 1: State Political Leanings



Saad, L. (2014, January 29). Not as Many U.S. States Lean Democratic in 2013. Retrieved from http://www.gallup.com/poll/167030/not-states-lean-democratic-2013.aspx